

him six specimens from the Caucasus, all of which agreed closely *inter se* in the characters given, in which this species differs from the other two species of Pied Flycatchers. I have in my own collection a fine adult male of *M. semitorquata* from Turkey, obtained many years ago by the late Mr. Robson; and on examining the series in the British Museum, I find that the specimens from Fao on the Persian Gulf, Bushire, and Persia are referable to this species, and not to *M. atricapilla* nor to *M. collaris*. It would therefore appear that *M. atricapilla* does not range further east than Turkey nor *M. collaris* than Asia Minor, being replaced east of those countries by *Muscicapa semitorquata*.

In conclusion I may add that Dr. Radde has also sent me several Long-tailed Titmice from Lenkoran and Tiflis, all of which are undoubtedly referable to *Acredula caucasica* and not to *A. caudata*.

5. The Skeleton of *Lorius flavopalliatu*s compared with that of *Psittacus erithacus*.—Part I. By ST. GEORGE MIVART, F.R.S.

[Received March 25, 1895.]

In a former paper, read on March 5, 1895, I described the hyoid bones of certain Parrots and, amongst them, compared those of *Lorius flavopalliatu*s with the same parts in *Psittacus erithacus*, having taken the latter as my type and standard of comparison.

The admirable works of Professor Alphonse Milne-Edwards on the Fossil Birds of France and on the Osteology of the Psittaci do not contain figures or descriptions of any species of *Loriidæ*, and the same must be said of Bronn's 'Thierreich' and (with a quite insignificant exception) of Fürbringer's magnificent publication in two folio volumes.

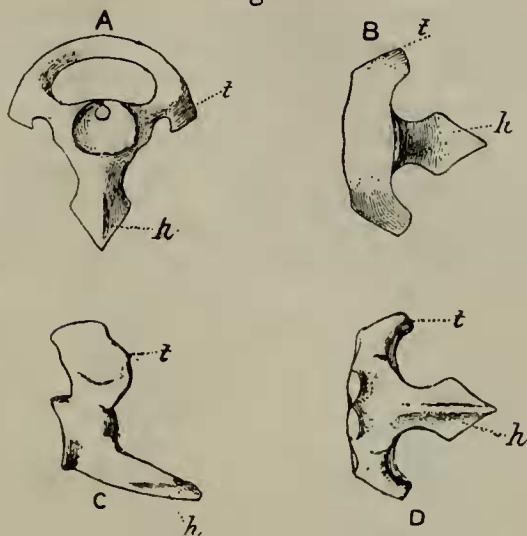
Such being the case, I have thought it worth while to describe in some detail the axial skeleton of a species of that interesting family which may possibly represent a more or less primitive form of the whole Order.

I have selected for description the skeleton of *Lorius flavopalliatu*s, the means so to do having been furnished me by this Society through the courtesy of our Prosector, Mr. F. Beddard, F.R.S. For the purpose of comparison with the skeleton of *Lorius*, I have again chosen that of the type of the order *Psittaci*, namely *Psittacus erithacus*; and I have to thank the late President of the Linnean Society, Mr. Charles Stewart, Hunterian Professor, for the loan of a skeleton of that species, and also Mr. Beddard for a spirit-specimen, the bones of which have been prepared for me by Mr. Ockenden with his wonted skill.

THE CERVICAL VERTEBRÆ.

The *atlas* in *L. flavopalliatu*s (fig. 1) has its pseudocentrum distinctly and largely perforated towards the dorsal part of its articular

Fig. 1.

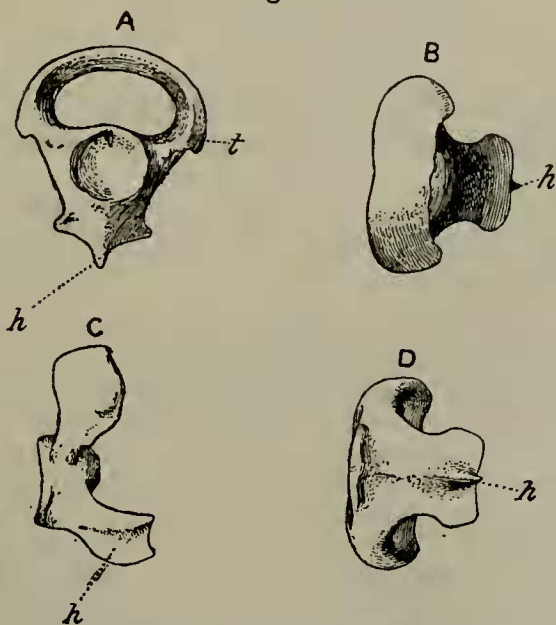


Atlas of *Lorius flavopalliatus*.

A. Anterior aspect. B. Dorsal aspect. C. Lateral aspect.
D. Ventral aspect.

h. Hypapophysis. | t. Transverse process.

Fig. 2.



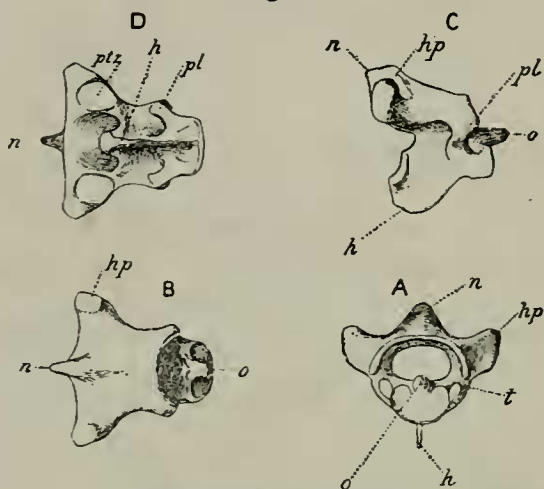
Atlas of *Psittacus erithacus*.

A. Anterior aspect. B. Dorsal aspect. C. Lateral aspect.
D. Ventral aspect.

h. Hypapophysis. | t. Transverse process.

cup, with a slight median notch above the perforation, the two portions bounding the latter dorsally not fusing together in the middle line but leaving a suture there. In *P. erithacus* (fig. 2, p. 313) the perforation is very much smaller and there is no suture above it. There is but a mere trace of a transverse process to be detected where the neural arch of the vertebra joins its lateral crura. Such a process is distinct in *L. flavopalliatius*, and it extends not only outwards but somewhat ventrad. The hypapophysis (*h*) is also relatively larger, hastate in shape, and more pointed than in *P. erithacus*, while its median ventral ridge is less strongly developed.

Fig. 3.

Axis of *Lorius flavopalliatius*.

- A. Anterior aspect. B. Dorsal aspect. C. Lateral aspect.
D. Ventral aspect.

h. Hypapophysis.
hp. Hyperapophysis.
n. Neural spine.
o. Odontoid process.

pl. Pleurapophysial lamella.
ptz. Postzygapophysis.
t. Transverse process.

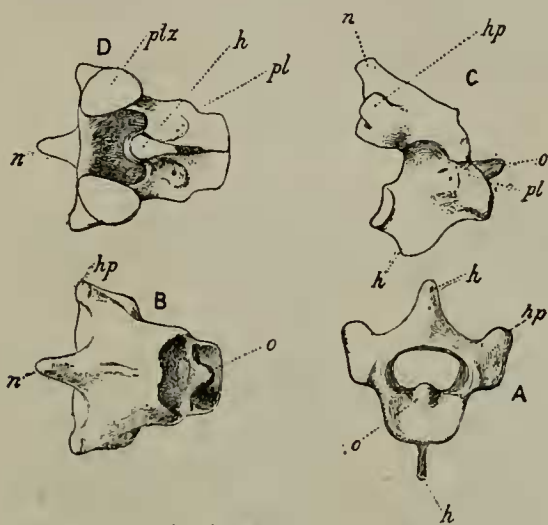
The *axis* in both (figs. 3 and 4) has a very small odontoid process (*o*), but only in *L. flavopalliatius* a small perforated transverse process (*t*), the delicate pleurapophysial lamella (*pl*) exhibiting a minute postaxiad process on its hinder margin. The neural spine is relatively, as well as absolutely, smaller, and the postzygapophyses, with very prominent hyperapophyses¹ upon them (*hp*), project more outwards and less backwards, making the lateral margin of the vertebra, seen dorsally, more concave. The hypapophysis (*h*) projects rather more backwards and less downwards, and the inferior margin of the vertebra, viewed laterally, is less strongly concave than in *P. erithacus*.

The *third vertebra* (figs. 5–10), viewed laterally, has, in both species, the outer margin of the longitudinal groove on the ventral

¹ So named by me in P. Z. S. 1865, p. 574, and Trans. Z. S. vol. viii. p. 390.

surface of the (*p*) parapophysis, or parapophysial lamella, more sharply developed than in the axis; the neural spine is more dorsad, the apices of the hyperapophyses (*hp*) even somewhat preaxiad. The hinder margin of the pleurapophysial lamella (*pl*) shows an inclination to develop two superimposed, postaxiad prominences.

Fig. 4.

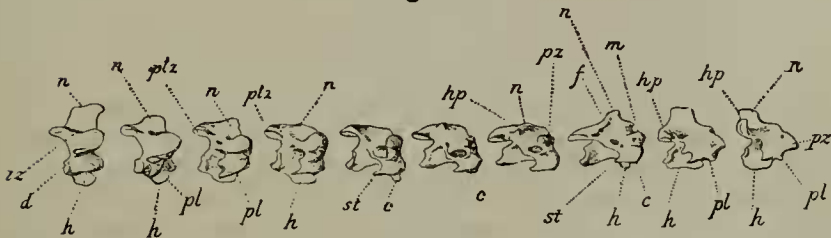


Axis of *Psittacus erithacus*.

- A. Anterior aspect. B. Dorsal aspect. C. Lateral aspect.
D. Ventral aspect.

<i>h</i> . Hypapophysis.	<i>o</i> . Odontoid process.
<i>hp</i> . Hyperapophysis.	<i>pl</i> . Pleurapophysial lamella.
<i>n</i> . Neural spine.	<i>ptz</i> . Postzygapophysis.

Fig. 5.



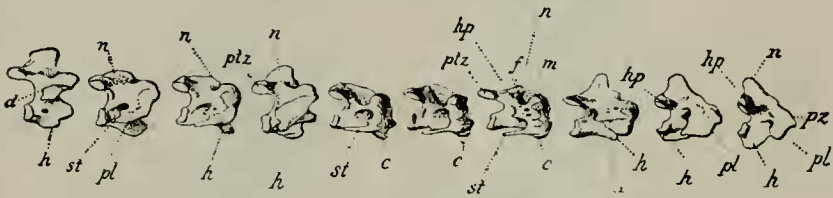
Lateral aspect of 3rd to 12th vertebrae of *Lorius flavopalliatus*.

<i>c</i> . Catapophysis.	<i>m</i> . Metapophysis.
<i>d</i> . Diapophysis.	<i>n</i> . Neural spine.
<i>f</i> . Foramen.	<i>pl</i> . Pleurapophysial lamella.
<i>h</i> . Hypapophysis.	<i>ptz</i> . Postzygapophysis.
<i>hp</i> . Hyperapophysis.	<i>pz</i> . Prezygapophysis.
<i>iz</i> . Interzygapophysial ridge.	<i>st</i> . Styliiform process.

The *fourth vertebra* has, in both species, the prezygapophyses (*pz*) extending much preaxiad. In *L. flavopalliatus* the neural

spine (*n*) is quadrate and directed almost exclusively dorsad, instead of being obtusely pointed and directed postaxiad as in *P. erithacus*. The postzygapophyses are almost entirely devoid of hyperapophyses. There are small and flattened ones as in *P. erithacus*. The postaxial margin of the pleurapophysial lamella also shows two superimposed postaxiad processes, the more ventral of which is continuous with the ridge bounding externally the antero-posterior groove on the ventral surface of the parapophysial lamella. The prezygapophysis bears a small prominence on its outer surface, which becomes noteworthy in the next vertebra.

Fig. 6.

Lateral aspect of 3rd to 12th vertebrae of *Psittacus erithacus*.

- | | |
|----------------------------|-------------------------------------|
| <i>c.</i> Catapophysis. | <i>n.</i> Neural spine. |
| <i>d.</i> Diapophysis. | <i>pl.</i> Pleurapophysial lamella. |
| <i>f.</i> Foramen. | <i>ptz.</i> Postzygapophysis. |
| <i>h.</i> Hypapophysis. | <i>pz.</i> Prezygapophysis. |
| <i>hp.</i> Hyperapophysis. | <i>st.</i> Styliform process. |
| <i>m.</i> Metapophysis. | |

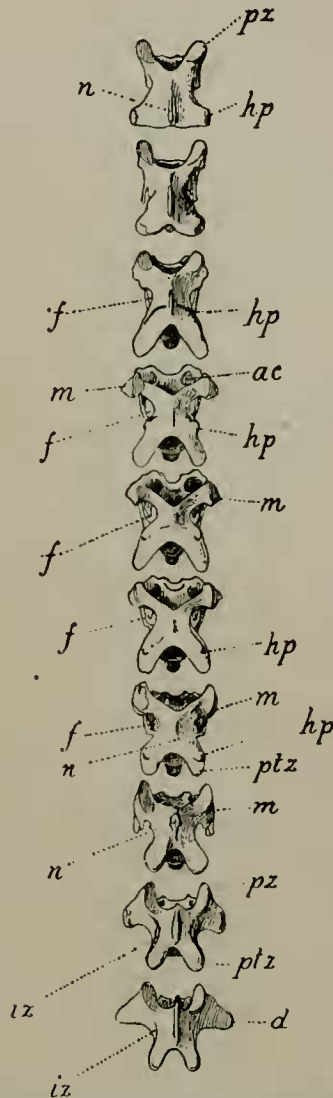
The *fifth vertebra* has the postzygapophyses much lengthened in both species, but especially in *L. flavopalliatius*, in which also the neural spine is smaller and more quadrate in outline. It arises some distance behind the preaxial end of the neural arch. In both species the hyperapophyses (*hp*) have the form of two small ridges diverging postaxiad from the hinder end of the base of the neural spine—more marked in *L. flavopalliatius*, in which species the hypapophysis is small and extends preaxiad from just behind and below the anterior central articular surface.

The ventral margin of the vertebra is much more antero-posteriorly concave than in *P. erithacus*. The ventral antero-posterior groove on the parapophysial lamella is almost obsolete, but the, here expanded, outer surface of the pleurapophysial lamella shows, above and preaxially, a rough prominent process (*metapophysis*) on the outer surface of the prezygapophysis (there is a rudiment of the metapophysis in the fourth vertebra), and, more ventrally, a very small process near the antero-inferior angle of the lamella on either side. These are *catapophyses*¹ (*c*). The ventral margin of that lamella gives rise at its postaxial end to a short styliform pleurapophysial process (*st*), which seems to answer to the lower of the two superimposed processes of the third vertebra. The higher of the two is much extended and joins the under surface of

¹ See *op. cit.* p. 401.

the postzygapophysis, so bridging over and enclosing a foramen (*f*) visible, on either side, when the vertebra is viewed dorsally. In *P. erithacus* there is no such foramen, though there are two prolongations from the postaxial margin of the pleurapophysial lamella, the more ventral one on more posterior vertebræ (*s*) becoming the styliform pleurapophysial process.

Fig. 7.



Dorsal aspect of 3rd to 12th vertebræ of *Lorius flavopalliatu*.

ac. Arterial canal.

d. Diapophysis.

f. Foramen.

hp. Hyperapophysis.

iz. Interzygapophysial ridge.

m. Metapophysis.

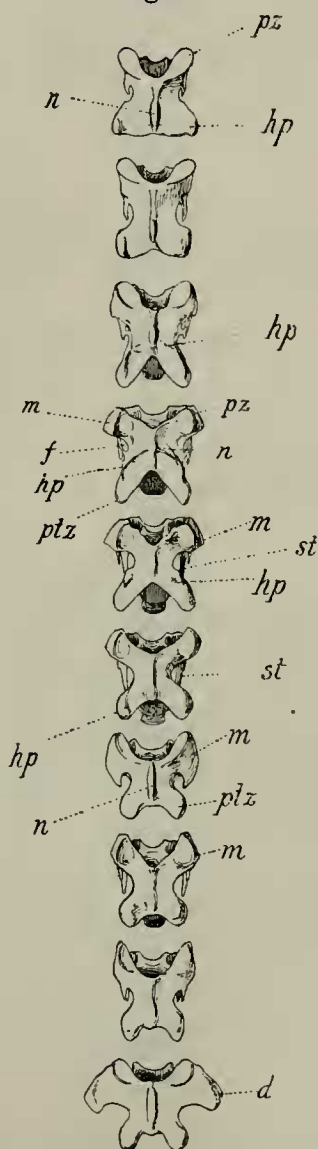
n. Neural spine.

ptz. Postzygapophysis.

pz. Prezygapophysis.

The *sixth vertebra* of *L. flavopalliatu*s has the postzygapophyses (*ptz*) not extending so far backwards as in the preceding bone. The neural spine (*n*) has almost disappeared, but on either side of it the hyperapophyses (*hy*) appear as marked processes which are altogether anterior to the postzygapophyses. The prezygapo-

Fig. 8.



Dorsal aspect of 3rd to 12th vertebræ of *Psittacus erithacus*.

d. Diapophysis.
f. Foramen.
hp. Hyperapophysis.
m. Metapophysis.

n. Neural spine.
ptz. Postzygapophysis.
st. Styliiform process.

physes (*pz*) look dorsad, mesiad, and almost slightly postaxiad, and so contrast strongly with those of the fifth vertebra. As they do not extend so much forward, the anterior ends of the lateral arterial canal (*ac*) are visible when the vertebra is viewed dorsally. The hypapophysis has disappeared, but the structure of the pleurapophysial lamella is otherwise much as in the fifth vertebra, save that the foramen (*f*) formed by its superior postaxial process is larger. In *P. erithacus* the conditions are similar, except that the neural spine is not so obsolete. In this species the sixth vertebra is the first and only one to have a lateral foramen (*f*) formed by the process of the pleurapophysial lamella. The catapophyses (*c*) are rather more marked than in the fifth vertebra. In both species the metapophyses (*m*) are prominent.

The seventh vertebra of *L. flavopalliatus* is very like the sixth, and the same may be said in the case of *P. erithacus*, except that in the latter species there is no lateral foramen and the pleurapophysial processes (*st*) are longer. In both, the catapophyses (*c*) are more developed than in the preceding vertebra and project preaxiad as well as ventrad. In both, the metapophyses (*m*) are as well developed as before.

The eighth vertebra has the catapophyses (*c*) again more prominent and approximated, and they are at their maximum. In *L. flavopalliatus* the hyperapophyses (*hp*) have almost disappeared, and hardly less so in *P. erithacus*. In both they have again receded and stand upon the postzygapophyses.

In the ninth vertebra the hypapophysis (*h*) suddenly reappears and is of large size in both species. The neural spine also reappears of considerable size, and is quadrate in shape in *P. erithacus*, but it is only represented by a very low and delicate ridge in *L. flavopalliatus*. In both species the postzygapophyses are shorter and less diverging than in the eighth vertebra. In *L. flavopalliatus* the lateral¹ foramen (*f*) has become slightly smaller. In both species the metapophyses (*m*) are rather more developed and are indeed at their maximum. In *L. flavopalliatus* there are still hyperapophyses (*hp*) on the postzygapophyses.

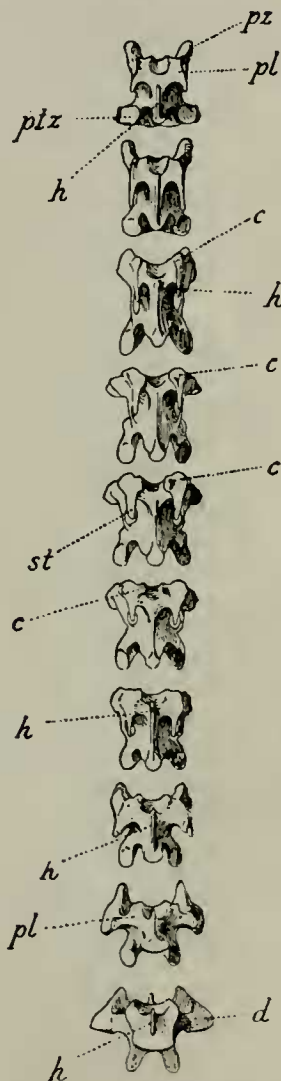
In the tenth vertebra the lateral foramen disappears in *L. flavopalliatus*, and the postaxial margin of the pleurapophysial lamella (*pl*) develops two processes projecting postaxiad and slightly ventrad. The neural spine (*n*) for the first time reappears as a distinct, though smaller pointed process. The postzygapophyses (*ptz*) are smaller than in the preceding vertebra, only projecting about as much backwards as the prezygapophyses do forwards. The hypapophysis (*h*) is much as in the ninth vertebra. In *P. erithacus* it is rather smaller than in the preceding vertebra, slightly bifurcating at its distal end, and the neural spine is certainly smaller. In both species the metapophyses (*m*) are rather smaller.

The eleventh vertebra in *L. flavopalliatus* bears a distinct, quadrate

¹ Not the canal enclosed by the pleurapophysial lamella as a whole (that persists on into the eleventh vertebra in both), but only that enclosed by the delicate upper postaxiad process of that lamella.

neural spine (*n*) and a hypapophysis (*h*) developed much as in the preceding vertebra. Both the pre- and postzygapophyses (*ptz*) project slightly less than in the tenth vertebra, and an antero-posterior external (interzygapophysial) ridge (*iz*) connects them—a trace of which is also to be seen in the tenth vertebra. The neural arch is the shortest, antero-posteriorly, since that of the atlas.

Fig. 9.



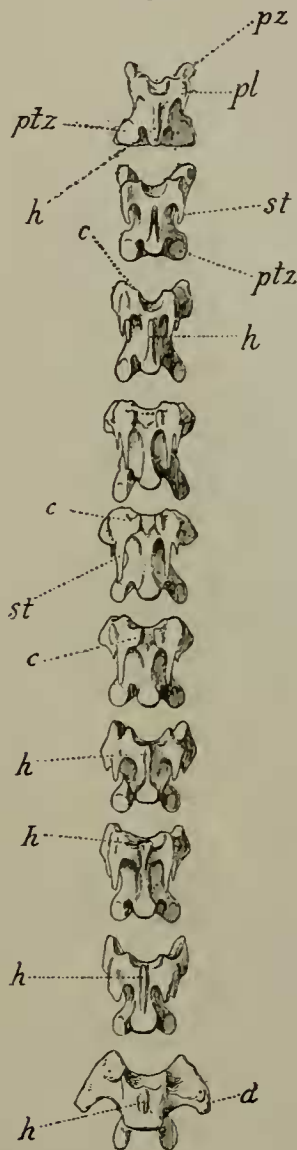
Ventral aspect of 3rd to 12th vertebrae of *Lorius flavopalliatu*.

c. Catapophysis.
d. Diapophysis.
h. Hypapophysis.
pl. Pleurapophysial lamella.

ptz. Postzygapophysis.
pz. Prezygapophysis.
st. Styliform process.

The most striking difference is the reduction in size of the pleurapophysial lamella (*pl*) antero-posteriorly. It has become a delicate ridge of bone, narrower antero-posteriorly than dorso-ventrally. It is antero-posteriorly grooved externally, the groove being

Fig. 10.



Ventral aspect of 3rd to 12th vertebrae of *Psittacus erithacus*.

c. Catapophysis.

d. Diapophysis.

h. Hypapophysis.

pl. Pleurapophysial lamella.

ptz. Postzygapophysis.

pz. Prezygapophysis.

st. Styliiform lamella.

bounded by two ridges, the postaxial end of each of which projects beyond the postaxial margin of the lamella, and correspond with the two similar directed, superimposed, postaxial processes of more anterior cervical vertebræ. In *P. erithacus* the conditions are similar save that the neural spine (*n*) is not so well developed (though slightly more so than in the tenth vertebra), while the pleurapophysial lamella is quite as long antero-posteriorly as in that vertebra, though the styliform, more ventral, process (*st*) projecting postaxiad from its hinder margin is shorter than is that of the same vertebra. The neural arch is not so preeminently shortened antero-posteriorly as in the Lory. In both species the metapophyses are smaller than in the preceding vertebra.

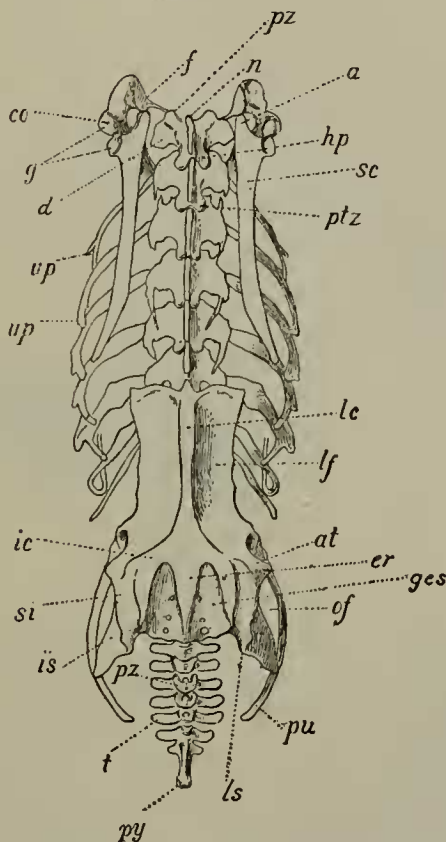
The *twelfth vertebra* of *L. flavopalliatu*s (figs. 5, 7, & 9) has the neural arch about as short antero-posteriorly as in the eleventh vertebra, while the pre- and postzygapophyses do not project more, and the interzygapophysial ridges (*iz*) are similarly developed. But the neural spine (*n*) is much more developed than in the eleventh vertebra; it is a high subquadrate process, highest preaxially. The hypapophysis (*h*) is of about the same size as in the eleventh vertebra, but the pleurapophysial lamella altogether makes default. There is a strong transverse process (*diapophysis*) (*d*) which serially corresponds with the ridge bounding dorsally the antero-posterior groove outside the pleurapophysial lamella of the eleventh vertebra—much enlarged. The ventral surface of the centrum is subquadrate in shape, the hypapophysis (*h*) depending from the hinder half of its antero-posterior middle. The ventral surface is bounded laterally by two ridges, the anterior ends of which project preaxiad as two processes one on either side of the preaxial central articular surface. The same two processes exist in the same parts (though to a less marked degree) in the tenth and eleventh vertebræ.

In *P. erithacus* (figs. 6, 8, & 10) this vertebra is similar save that (like the eleventh) it is not so much smaller than more preaxial cervical vertebræ. In both species the metapophyses have here become obsolete.

The *thirteenth vertebra*, in both, is very similar to its serial predecessor save that its neural spine (*n*) is more extended antero-posteriorly, that its hypapophysis is more pointed, that its zygapophyses are smaller, but with some reappearance of hyperapophyses (*hp*), its diapophysis (*d*) more antero-posteriorly wide and presenting a small concave articular surface on its ventral aspect, towards its postero-external angle, for the tuberculum (*tp*) of the first cervical rib, and another (*cp*) for its capitulum on the outer side of the centrum, a little behind the process which projects forwards outside the preaxial central articular surface. This process in *P. erithacus* has here (figs. 13, 14, & 15, pp. 325 & 326) begun to subdivide into two processes connected by a short ridge: one, more dorsal (*x*), on one side of the middle of the central articular surface; the other, more ventral (*c*), at the preaxial end of the ridge bounding laterally the ventral surface of the centrum. These latter processes may be regarded as catapophyses which here make their appearance

more. This subdivision accompanies a slight increase in the dorso-ventral perforation of this vertebra compared with that of the preceding one. In *L. flavopalliatus* this subdivision does not take place. The hypapophysis is more quadrate in *P. erithacus*.

Fig. 11.

Dorsal aspect of thorax, pelvis, and tail of *Lorius flavopalliatus*.

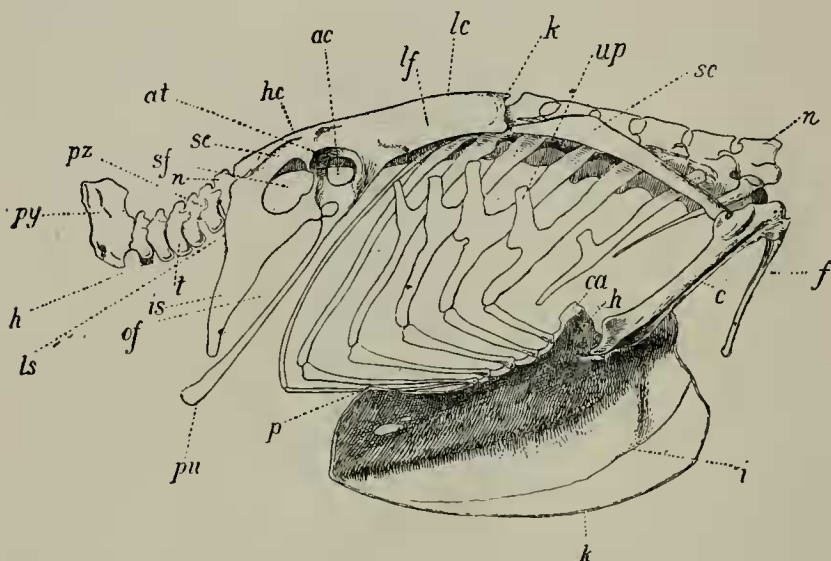
a. Acromion.
at. Antitrochanteric process.
co. Coracoid.
d. Diapophysis.
er. Sacral escutcheon.
f. Furculum.
g. Glenoid surfaces.
ges. Groove beside sacral escutcheon.
hp. Hyperapophysis.
ic. Lateral iliac ridge.
is. Ischium.
lc. Crest of ilium.

lf. Iliac fossa.
ls. Ilio-caudal spine.
n. Neural spine.
of. Obturator foramen.
ptz. Postzygapophysis.
pu. Pubis.
pz. Prezygapophysis.
py. Pygostyle.
sc. Scapula.
si. Sacro-ischiatric ridge.
t. Transverse process.
up. Uncinate process.

The *fourteenth vertebra* in *L. flavopalliatus* is like its thirteenth save that the neural spine (*n*) is more extended antero-posteriorly. In *P. erithacus* the subdivision spoken of as having taken place in the thirteenth vertebra is here more decided, the catapophyses

appearing as processes projecting outwards and forwards from the sides of the hypapophysis (*h*) not much above its ventral end. The catapophyses (*c*), when the vertebra is viewed ventrally, appear as the ends of two ridges diverging preaxial from the postaxial margin of the hypapophysis (*h*).

Fig. 12.

Lateral aspect of thorax, pelvis, and tail of *Lorius flavopalliatius*.

- | | |
|---|--------------------------------------|
| <i>ac</i> . Acetabulum. | <i>lc</i> . Anterior crest of ilium. |
| <i>at</i> . Antitrochanteric process. | <i>lf</i> . Iliac fossa. |
| <i>c</i> . Coracoid. | <i>ls</i> . Ilio-caudal spine. |
| <i>ca</i> . Costal angle. | <i>n</i> . Neural spine. |
| <i>f</i> . Furculum. | <i>of</i> . Obturator foramen. |
| <i>h</i> (of tail). Hypapophysis. | <i>p</i> . Angle of sternum. |
| <i>h</i> (of sternum). Muscular impression. | <i>pu</i> . Pubis. |
| <i>hc</i> . Lateral crest. | <i>pz</i> . Prezygapophysis. |
| <i>i</i> . Intermuscular ridge. | <i>py</i> . Pygostyle. |
| <i>is</i> . Ischium. | <i>sc</i> . Scapula. |
| <i>k</i> (of sternum). Keel. | <i>sf</i> . Sacro-sciatic foramen. |
| | <i>up</i> . Uncinate process. |

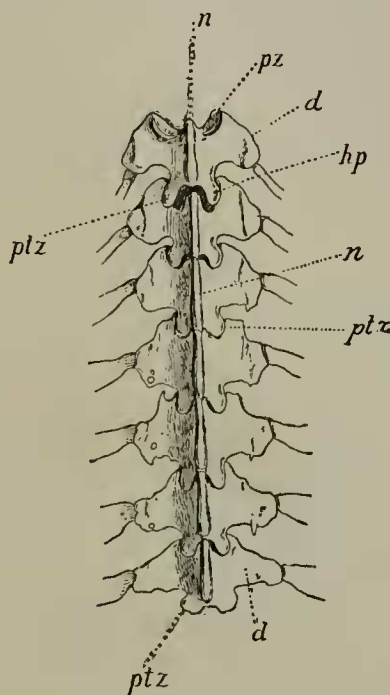
THE DORSAL VERTEBRÆ.

There are, in *L. flavopalliatius* and *P. erithacus*, four of these vertebræ distinct from the sacral mass.

The first dorsal vertebra in *P. erithacus* (figs. 13, 14, & 15) is very like the last cervical, except that the postzygapophyses (*ptz*) are slightly shorter and the transverse process (*t*) slightly more extended antero-posteriorly. The hypapophyses (*hp*) have disappeared, but the hinder end of the summit of the neural spine (*n*) slightly bifurcates and receives between its short processes the preaxial summit of the neural spine behind it. The tubercular and capitular

articular surfaces are slightly further apart. The centrum is more laterally compressed and more vertically and also antero-posteriorly extended, the hypapophysis is longer and trifid at its extremity, the two catapophyses having descended nearly to its apex.

Fig. 13.

Dorsal aspect of 13th to 19th vertebræ of *Psittacus erithacus*.

d. Diapophysis.
hp. Hyperapophysis.
n. Neural spine.

ptz. Postzygapophysis.
pz. Prezygapophysis.

In *L. flavopalliatus* the conditions are similar save that the hypapophysis is simple, and that the centrum is not so much more vertically and antero-posteriorly extended than is the last cervical vertebra.

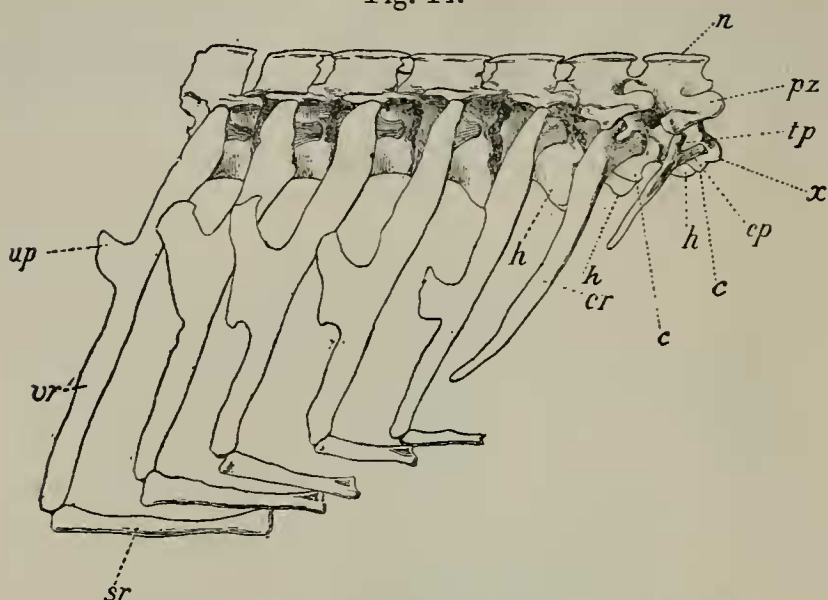
In both species the centrum is extremely narrow transversely. The hinder articular surface of the centrum is concave, but its anterior ventral surface is slightly saddle-shaped in both species.

The second dorsal vertebra is very like the first, but the hypapophysis, in *P. erithacus*, ends distally in a hook-shaped pointed process which curves forwards beneath the hinder part of the body of the preceding vertebra. In *L. flavopalliatus* the conditions are generally similar.

The central articular surfaces are convex anteriorly and concave posteriorly.

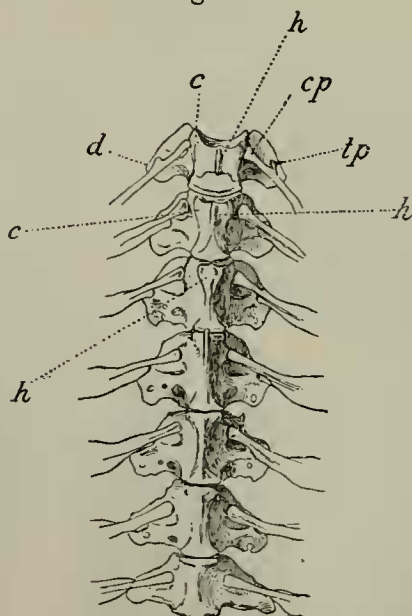
The third dorsal vertebra is very like the second, but the post-

Fig. 14.

Lateral aspect of 13th to 19th vertebræ of *Psittacus erithacus*.

c. Catapophysis.	n. Neural spine.	up. Uncinate process.
cp. Capitulum.	pz. Prezygapophysis.	vr. Vertebral rib.
cr. Cervical rib.	sr. Sternal rib.	x. Dorsal part of subdivi-
h. Hypapophysis.	tp. Tuberculum.	sion of catapophysis.

Fig. 15.

Ventral aspect of 13th to 19th vertebræ of *Psittacus erithacus*.

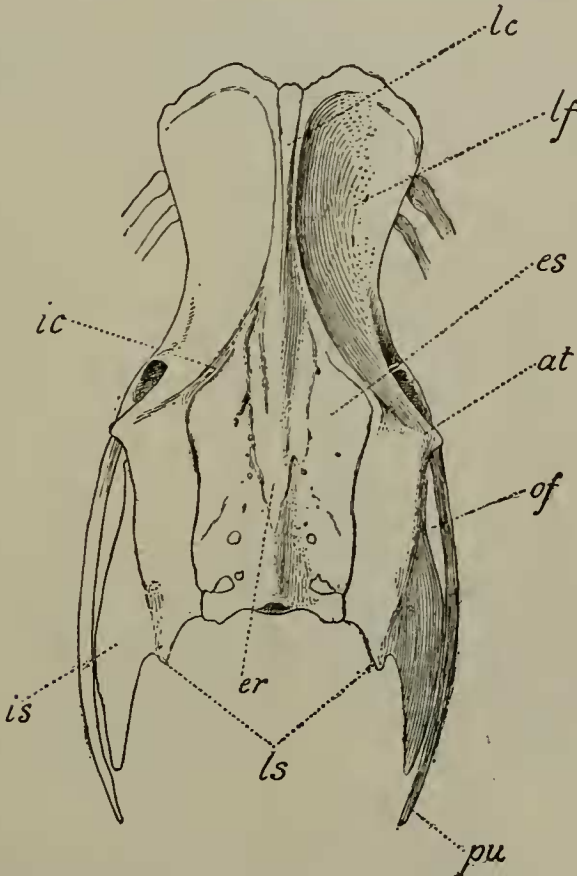
c. Catapophysis.	d. Diapophysis.	tp. Tuberculum.
cp. Capitulum.	h. Hypapophysis.	

zygapophyses (*ptz*) are again slightly smaller, the tubercular and capitular perhaps rather farther apart. There is no hypapophysis. The centrum is not quite so narrow transversely as it is in the first and second dorsal vertebræ. The articular surfaces of the centrum are again slightly convex in front and decidedly concave behind in both species.

The *fourth dorsal vertebra* is very like the third save that its centrum is slightly shorter antero-posteriorly and not quite so compressed laterally, and that the summit of the neural spine ceases to bifurcate at its hinder end. The centrum is again convex anteriorly and concave posteriorly.

The *fifth dorsal vertebra* has its centrum again somewhat shorter and less laterally compressed, and the articular surfaces for the

Fig. 16.

Dorsal aspect of sacrum and pelvis of *Psittacus erithacus*.

at. Antitrochanteric process.
er. Median part of sacral escutcheon.
es. Lateral part of the same.
ic. Lateral iliac ridge.
is. Ischium.

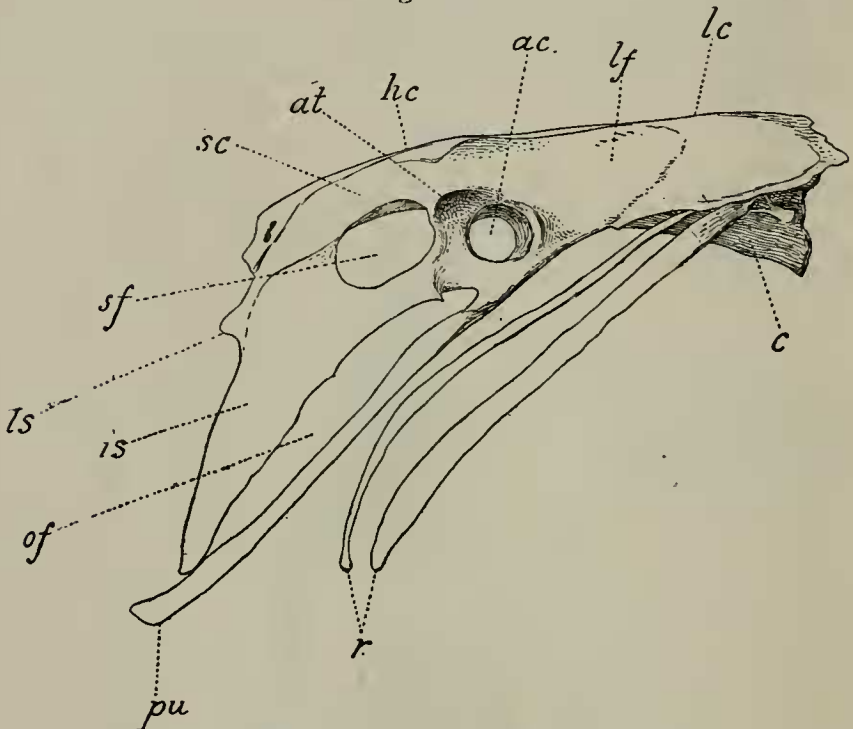
lc. Iliac crest.
lf. Iliac fossa.
ls. Ilio-caudal spine.
of. Obturator foramen.
pu. Pubis.

tuberculum and capitulum not quite so far apart. The posterior articular surface of the centrum is concave.

THE SACRUM.

This mass of anchylosed vertebræ (figs. 16, 17, 18, & 19) apparently consists in both species of four *lumbo-sacral vertebræ*, an indeterminable number of *sacral vertebræ*, and from five to six, probably seven, *uro-sacral vertebræ*.

Fig. 17.



Lateral aspect of sacrum and pelvis of *Psittacus erithacus*.

- | | |
|--------------------------------------|-------------------------------------|
| <i>ac.</i> Acetabulum. | <i>ls.</i> Ilio-caudal spine. |
| <i>at.</i> Antitrochanteric process. | <i>of.</i> Obturator foramen. |
| <i>c.</i> Lumbo-sacral vertebra. | <i>pu.</i> Pubis. |
| <i>hc.</i> Lateral crest of ilium. | <i>r.</i> Sacral ribs. |
| <i>lc.</i> Crest of ilium. | <i>sc.</i> Posterior part of ilium. |
| <i>lf.</i> Iliac fossa. | <i>sf.</i> Sacro-sciatic foramen. |

THE LUMBO-SACRAL VERTEBRÆ.

These four vertebræ are anchylosed together with the ilium (*il*), and, of course, with the solid mass of the true sacral vertebræ.

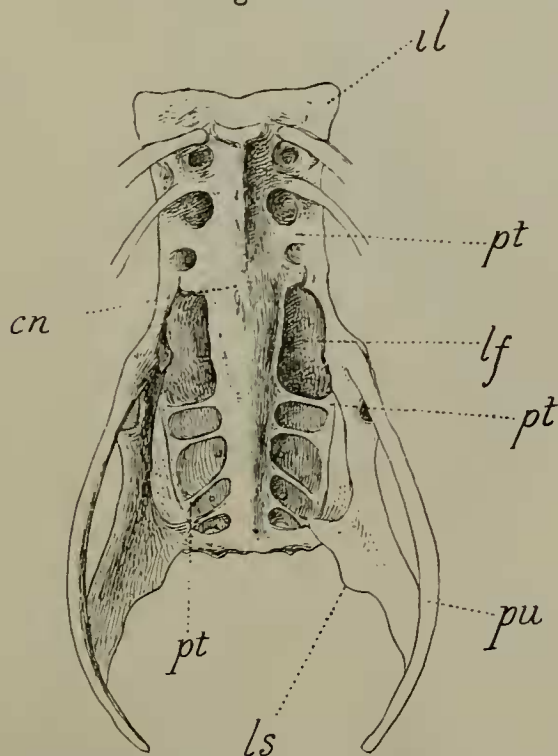
The *first lumbo-sacral vertebra* seen preaxially exhibits its neural arch, prezygapophyses, neural spine, and transverse processes, each presenting a concave tubercular surface, while outside the base of the neural arch just above the centrum is the capitular cup. The preaxial surface of the centrum is concave,

The *second lumbo-sacral* vertebra is indistinguishable save for its parapophysial transverse process (*pt*) and thereto anchylosed long ribs, between which and the transverse process of the preceding vertebra a fossa appears. Thus, when the ventral surface of the sacrum is looked at, a fossa appears on either side between the two transverse processes of the preceding and those of the present vertebra.

The *third lumbo-sacral* vertebra in *Lorius flavopalliatus* bears no rib but only a short parapophysial transverse process on either side (*pt*), which anchyloses distally with the ilium and is slightly more antero-posteriorly extended than that of the preceding vertebra. Between these two transverse processes and those of the second lumbo-sacral vertebra a fossa is to be seen (on the ventral aspect of the sacrum) on either side, of about the same size as those between the transverse processes of the first and second lumbo-sacral vertebræ. The transverse diameter of the centrum is slightly wider than that of the preceding vertebra.

The *fourth lumbo-sacral* vertebra is quite similar to the preceding one in *L. flavopalliatus*, but in *P. erithacus* its transverse process

Fig. 18.

Ventral aspect of sacrum of *Lorius flavopalliatus*.

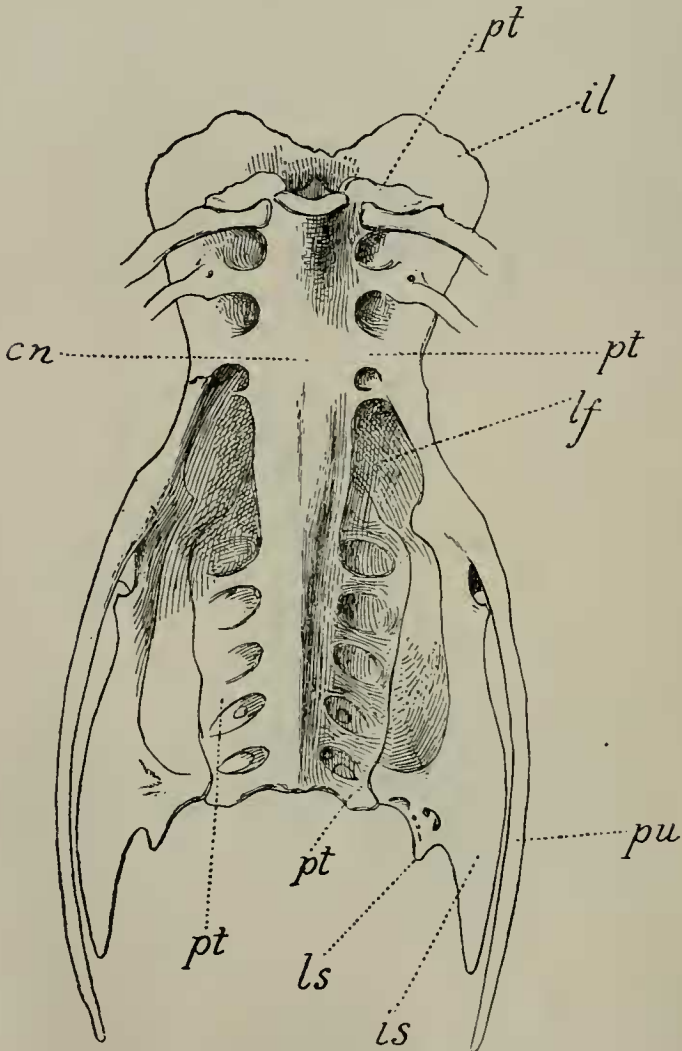
cn. Fused sacral vertebræ.
il. Ilium.
lf. Lateral fossa.

ls. Ilio-caudal spine.
pt. Parapophysial process.
pu. Pubis,

is more slender than its serial predecessor. The fossa between it and that of the third lumbo-sacral vertebra is smaller than those between the transverse processes of the preceding vertebræ, but the difference is not so great in *L. flavopalliatum* as in *P. erithacus*. The centrum is again slightly wider than that of its preceding vertebra.

The ventral surface of the lumbo-sacral vertebræ is somewhat keeled, ridge-like, in *L. flavopalliatum*, but not so in *P. erithacus* (*cn*).

Fig. 19.

Ventral aspect of sacrum of *Psittacus erithacus*.

cn. Fused sacral vertebræ.
il. Ilium.
is. Ischium.
lf. Lateral fossa.

ls. Ilio-caudal spine.
pt. Parapophysial process.
pu. Pubis.

THE SACRAL VERTEBRÆ.

The solid mass formed by these vertebræ (figs. 18 & 19) is longer than broad and narrows gently backwards. Its ventral surface is slightly grooved antero-posteriorly in its middle. It develops no parapophysial transverse processes, and so a large long fossa (*lf*) lies on either side of it, roofed by the ilium and bounded in front by the parapophysial transverse process of the last lumbo-sacral vertebra and behind by the transverse process of the first uro-sacral vertebra. Rudiments of diapophysial portions of transverse processes appear to coalesce with the ventral surface of the ilium of this region.

THE URO-SACRAL VERTEBRÆ.

These vertebræ (figs. 16, 18, & 19) continue on postaxially the sacral mass, narrowing gradually as they proceed. It develops a series of parapophysial transverse processes (*pt*), six at least on each side, which extend outwards, backwards, and slightly upwards, anchylosing with the ischium at their apices. They anchylose with it also for more or less, or for the whole, of their extent in *P. erithacus*. The diapophysial elements of the transverse processes are widely extended antero-posteriorly, and unite so as to form the dorsal sacral escutcheon (*es*), which is a continuous sheet of bone save for the sacral foramina, which indicate the limits of the diapophysial transverse processes—interposed between the hinder halves of the two ilia and the two ischia. In *L. flavopalliatus* each of the transverse processes on either side of the first uro-sacral vertebra is quite separate from the ischium above it till close to the apex of the transverse process, when it anchyloses therewith. Its dorsal sacral escutcheon also is almost entirely postaxial to the acetabula instead of extending in front of them as in *P. erithacus*, and presents on either side a marked antero-posterior groove (*ges*), widening backwards from its apex, which is placed in a line nearly coincident with the hinder margin of the acetabulum. These two grooves are separated by a strongly-marked antero-posteriorly extending ridge (narrowing postaxiad), which is only faintly indicated in *P. erithacus*.

THE CAUDAL VERTEBRÆ.

There are six caudal vertebræ in *L. flavopalliatus* (fig. 12, p. 324), with variously developed neural spines, zygapophyses, transverse processes (*t*), and hypapophyses.

The first three caudal vertebræ have transverse processes (*t*) which are simple, flattened above and below, and slightly increase in length from the first to the fourth caudal vertebra. Those of the first are about as long as those of the last uro-sacral vertebra. The prezygapophyses (*pz*) of the first of these vertebræ extend but very slightly forward, those of the other two extend preaxiad more and more.

The *first caudal* vertebra has a small, quadrate, low, neural spine (*n*) and two prezygapophyses which extend but very slightly forwards, while the postzygapophyses are very small indeed. The transverse processes are simple, flattened above and below, and about as long as those of the last uro-sacral vertebra. The ventral surface of the centrum presents at its ventral margin two blunt hypapophysial processes, which abut against the postero-inferior margin of the sacrum.

The *second caudal* vertebra is similar to the last except that the neural spine is not so quadrate (being highest preaxially), the prezygapophyses (*pz*) are slightly larger, the postzygapophyses more developed, while small hyperapophyses reappear upon them. The transverse processes (*t*) are slightly longer, while the two hypapophysial processes are clearly approximated and project slightly more preaxiad.

The *third caudal* vertebra has again the same characters carried slightly further, while the hypapophysis has become single and projects slightly forward beneath, and applied to, the ventral surface of the second caudal.

The *fourth caudal* vertebra has its neural spine and prezygapophyses inclined strongly preaxiad, the hyperapophyses slightly larger and the transverse processes slightly longer (both are here at their maximum in the caudal region), while the hypapophysis is a little more developed, ventrally grooved antero-posteriorly, and tending to bifurcate at the apex, and developed, as before, from the preaxial end of the centrum.

The *fifth caudal* vertebra has its transverse processes slightly shorter, the neural spine less inclined preaxiad, and hyperapophyses much smaller and more preaxially placed. The hypapophysis is long, situated at the preaxial margin of the centrum, and bifurcates distally.

The *sixth caudal* vertebra has all its parts and processes diminished save the hypapophysis (*h*), which is somewhat longer and stouter, still less inclined preaxiad, but still distally bifurcating into two lateral processes diverging slightly more than those of the fifth caudal vertebra.

THE PYGOSTYLE.

The pygostyle in *L. flavopalliatu*s (*py*, fig. 12, p. 324) is a laterally much compressed subquadrate plate of bone with anterior, superior, and posterior margins, while inferiorly it carries on, as it were, the series of caudal vertebræ. At its preaxial end below are minute transverse processes and prezygapophyses, which latter adjoin the corresponding parts of the last caudal vertebra.

From its ventral surface a process depends which is in series with the hypapophyses in front.

The preaxial margin of the plate is strongly concave, the post-axial margin slightly so. The former margin is entirely thin, but the posterior one is medianly thin but thickened, though flattened,

below and more so dorsally. The superior margin of the plate is in the form of a thin crest convex medianly and bifurcating laterally at its postaxial end (*py*), at the dorsal margin of the upper flattened part of the hinder margin.

In *P. erithacus* the pygostyle is essentially similar, save that it is a triangular rather than a quadrate plate. It would resemble that of *L. flavopalliatus* if from the latter all was cut off preaxial to a line passing from the superior extremity of its hinder margin obliquely downwards and forwards to a point between the prezygapophyses.

THE RIBS.

There are eight or nine dorsal and five ventral ribs on each side (figs. 12 & 14).

The Dorsal Ribs.

In both species there are two cervical ribs and six or seven true thoracic ribs, whereof five are articulating with the sternum, while one or two are floating ribs.

The Cervical Ribs.

The *first cervical* rib is, in both species, long, slender, styliform, and devoid of any uncinat process. The tubercular and capitular processes are of about equal length.

The *second cervical* rib is about one-third longer than the first and generally bears an uncinat process (*up*). If so this is short and does not expand dorso-ventrally at its distal end. The capitular process is somewhat longer than the tubercular one.

The Thoracic Ribs.

The *first thoracic* rib is a little longer and stouter than the second cervical, and its uncinat process (*up*) expands distally into a short ventrad and longer dorsad and postaxiad process, so it is much longer dorso-ventrally than antero-posteriorly.

The *second thoracic* rib is again slightly longer, while its uncinat process has a longer dorsal process and a shorter ventral margin. The tuberculum is slightly more distant from the capitulum than in the first true rib.

The *third thoracic* rib carries a little further the same modifications, save that the uncinat process in *L. flavopalliatus* loses entirely the quadrate shape and is subtriangular with a truncated apex. Its distance from the distal end of the rib is also greater. It may still be subquadrate in form in *P. erithacus*.

The *fourth thoracic* rib has in the last-named species a much smaller and simply shaped uncinat process, which is still further removed from the rib's apex.

L. flavopalliatus differs from *P. erithacus* in that all the ribs are more slender (relatively as well as absolutely), while the uncinat

processes are relatively longer and more slender, notably that of the fourth true rib.

The *fifth thoracic* rib is more slender, and is very slender in *L. flavopalliatum*, in which it bears no uncinat process. It may bear a small and simple one in *P. erithacus*.

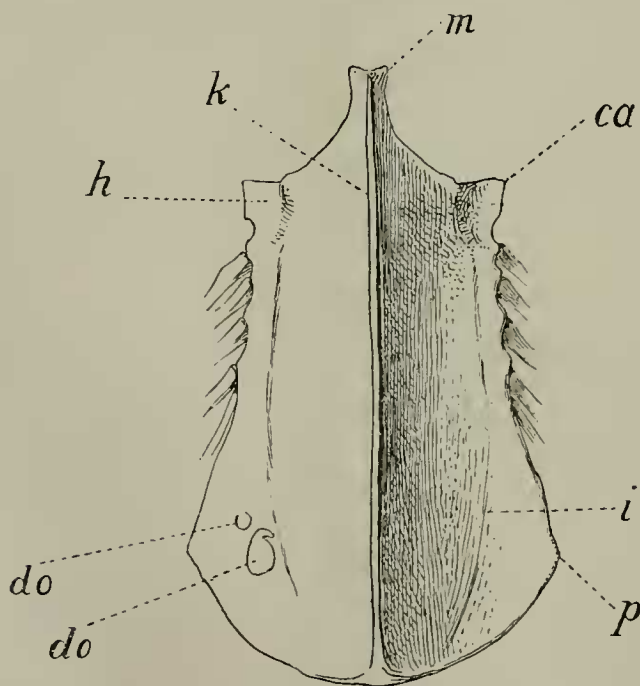
The sixth thoracic or *first floating rib* is longer than the fifth true rib, and still more slender, and is more or less ankylosed to the sacrum.

No seventh thoracic or *second floating rib* is developed in *L. flavopalliatum*, but may be present in *P. erithacus*. Then it is long, very slender, and ankyloses with the sacrum.

The Sternal Ribs.

There are five sternal ribs (figs. 12 & 14, pp. 324, 326) on each side which articulate dorsally with the respective apices of the thoracic ribs and ventrally with the sternum. The last three are expanded dorso-ventrally at their proximal ends. They are expanded transversely at their distal ends; each presenting there a surface some-

Fig. 20.



Ventral aspect of sternum of *Lorius flavopalliatum*.

ca. Costal angle.
do. Defect of ossification.
h. Muscular impression.
i. Intermuscular ridge.

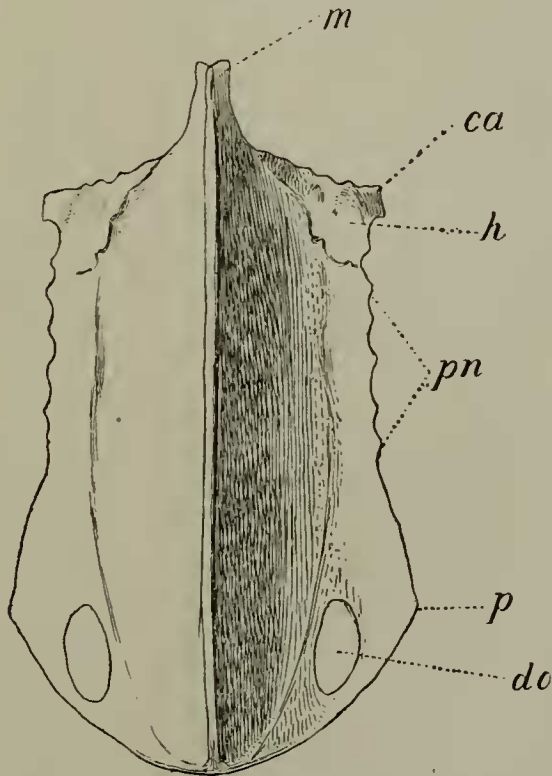
k. Keel.
m. Manubrium.
p. Lateral angle.

what hourglass-shaped, with two slight concavities to articulate with corresponding slight convexities on the pleurosteon (*plu*) of the sternum.

They increase rapidly in length from the first to the fifth; they are also somewhat longer, relatively, in *L. flavopalliatus* than in *P. erithacus*, especially the first on either side.

In *P. erithacus* it is shorter than the distance from the apex of the first thoracic rib to the ventral margin of the uncinate process. In *L. flavopalliatus* it is longer than that distance, and the same is the case as regards the three following sternal ribs in that species. In *P. erithacus* the three following ones about equal the length of their corresponding thoracic rib, from its apex to the ventral margin of the uncinate process.

Fig. 21.



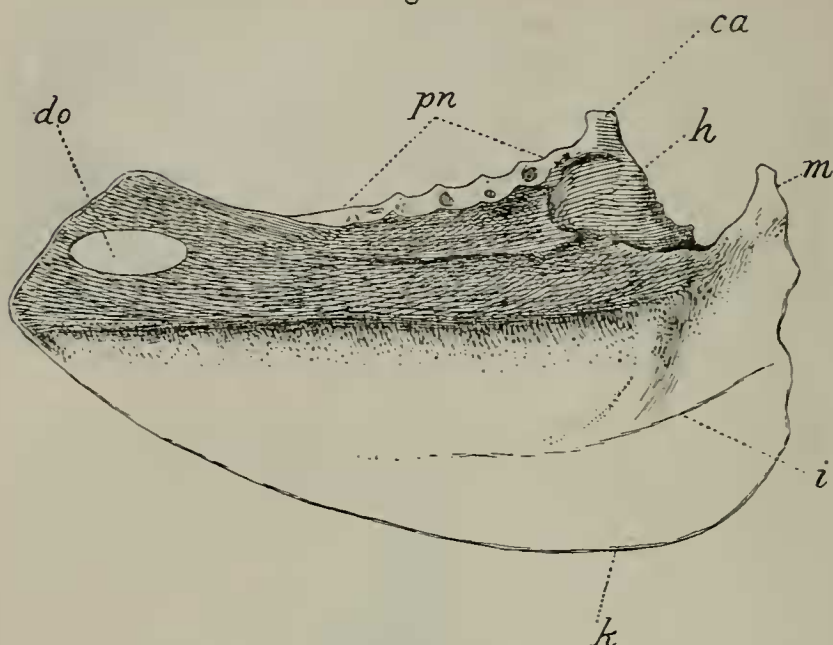
Ventral aspect of sternum of *Psittacus erithacus*.

ca. Costal angle.
do. Defect of ossification.
h. Muscular impression.

m. Manubrium.
p. Lateral angle.
pn. Pleurosteon.

The sternal rib corresponding with the first floating thoracic rib does not articulate with the sternum, but rather applies itself to the postaxial surface of the fifth sternal rib near to its distal end.

Fig. 22.

Lateral aspect of sternum of *Psittacus erithacus*.

ca. Costal angle.
do. Defect of ossification.
h. Muscular impression.
i. Intermuscular ridge.

k. Keel.
m. Manubrium.
pn. Pleurosteon.

THE STERNUM.

The sternum (figs. 20, 21, & 22) has, in both species, the simple form so common in the Parrots. The only differences I have remarked are that in *L. flavopalliatu*s the keel (*k*) projects preaxiad decidedly in front of the manubrium (*m*); the intermuscular ridge (*i*) on the side of the ventral surface of the sternum is slightly nearer to the pleurosteon; the lateral margin behind the attachment of the fifth sternal rib exceeds the length of the pleurosteon measured from that point to the posterior margin of the attachment of the first sternal rib. The surface of the sternum is also more entire, the costal angle (*ca*) extends less dorsad relatively, while its summit is antero-posteriorly broadened and the manubrium is differently shaped. In *P. erithacus* it appears (*m*) rather pointed towards its apex when viewed laterally. The anterior surface presents a long vertical groove gradually tapering ventrad; above this, a hardly noticeable tendency to bifurcation may be detected. Posteriorly it is transversely convex and not at all grooved longitudinally. Its anterior margin, below the anterior groove, is concave preaxiad, while its posterior margin is concave postaxiad.

The internal surface of the sternum presents at its preaxial end two strongly marked transverse prominences just behind and

corresponding with the dorsal margins of the coracoid grooves. From their median junction a less strongly marked ridge runs a short distance postaxiad, a marked fossa existing on either side of it and behind the transverse prominences. Numerous small foramina open round the margins of these fossæ and thence backwards over a considerable part of the internal surface of the sternum. In both species the pleurosternum has six excavations divided by five septa, each of which bears two superimposed convexities for one of the sternal ribs.

In *L. flavopalliatus* the manubrium, when laterally viewed, appears less elongated and less pointed towards its apex. Its anterior surface presents a rounded cup, in the place of an elongated groove, but the tendency to lateral bifurcation is rather more marked. The anterior margin, below the anterior cup, is convex preaxiad.

The internal surface of the sternum has only faint lateral ridges coinciding with the dorsal margins of the coracoid grooves, and there is no postaxiad median ridge, but in its place a large foramen leading into the substance of the bone.

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